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Supplement to a Revision of the Bee Genus *Ctenocolletes* (Hymenoptera: Stenotritidae)

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Abstract

Ctenocolletes nigricans sp. nov. and the male of *C. fulvescens* Houston are described from Western Australia. Extensions of the known ranges of several species are recorded and a key to the 10 known species of *Ctenocolletes* is provided.

Introduction

My revision of the genus *Ctenocolletes* Cockerell (Houston 1983a) recognised eight species. One of them, *C. fulvescens* Houston, was described on the basis of the unique female holotype. Subsequently (Houston 1983b), a ninth species, *C. tigris* Houston, was described from the Great Victoria Desert of Western Australia. The present paper is based on material collected since publication of the above-mentioned works and adds a further species to the genus bringing the total to 10. A series of specimens of *C. fulvescens* is now available and permits description of the male for the first time. Although *fulvescens* is clearly correctly assigned to *Ctenocolletes*, it lacks one of the chief diagnostic characters of the genus (a pygidial plate in the male) and the significance of this is discussed. Recent collecting has greatly extended the known range of *C. tigris* and more clearly defined the ranges of some other species. A revised key incorporating all known species of *Ctenocolletes* is provided to enable ready identification.

Most of the material examined was collected by myself and my colleagues R. Peter McMillan and Brian P. Hanich. For economy of space, only our initials (TFH, RPM and BPH, respectively) are given in the lists of specimens examined. Except where otherwise stated, all specimens are in the Western Australian Museum (WAM). Some are in the Australian National Insect Collection, CSIRO, Canberra (ANIC).

Terminology used here follows my revision (Houston 1983a) and the following abbreviations for relative dimensions are employed: C2L, length of spur (calcar) of mid tibia; F1L, length of attenuated first segment of flagellum; FRL, length of remainder of flagellum; HL, length of head; HW, width of head; LID, lower interocular distance; MBW, basal width of mandible (viewed ventrally); MFW,

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minimum width of face; ML, length of mandible; MOD, diameter of median ocellus; OOD, ocellocular distance; SL, length of scape; UID, upper interocular distance.

Systematics

Family Stenotritidae

Genus *Ctenocolletes* Cockerell, 1929

Key to the Species of *Ctenocolletes*

1 Male with pygidial plate; both sexes with metasomal integument black (metallic green in *smaragdinus*) 2

Male lacking pygidial plate; both sexes with metasomal integument orange-brown ..... *C. fulvescens*

2 Female with arolia; male with compound eyes slightly to strongly converging above (minimum width of face occurs above level of ocelli); metasomal pubescence forming conspicuous segmental bands (sometimes narrow and interrupted medially) 3

Female lacking arolia; male with compound eyes never converging above (minimum width of face occurs at or below level of antennal sockets); metasomal pubescence not forming conspicuous segmental bands 8

3 Metasoma with predominantly black and white pubescence; white tomentum forming narrow apical bands on first 3-5 terga, sharply differentiated in female from black or orange pubescence of terga 5 and 6; fore tarsal claws of male asymmetrical, inner claw enlarged and modified 4

Metasoma with predominantly buff to orange pubescence; in female, lighter orange or buff pubescence of anterior terga grading into brighter orange pubescence of apical terga; fore tarsal claws of male symmetrical 6

4 Facial pubescence white or off-white; metasomal tergum 4 (female) or 5 (male) with an apical band of white tomentum; inner fore tarsal claw of male with prongs strongly modified; lateral portions of metasomal terga 3 and 4 of female convex, translucent and hollow beneath (forming acarinaria and often containing mites) 5

Facial pubescence golden or rust coloured; metasomal tergum 4 (female) or 5 (male) without an apical band of white tomentum; inner fore tarsal claw of male with prongs hardly modified; lateral portions of metasomal terga 3 and 4 of female unmodified, lacking acarinaria ..... *C. tricolor*

5 Male with inner fore tarsal claw narrowest at mid section (viewed anteriorly), no more than 1.3X as long as outer claw; female with pubescence of metasomal terga 5 and 6 orange ..... *C. albomarginatus*

Male with inner fore tarsal claw widest at mid section (viewed anteriorly), at least 1.5X as long as outer claw (Figure 6); female with pubescence of metasomal terga 5 and 6 black ..... *C. nigricans*

6 Male with fore and hind basitarsi attenuated and curved, and fore trochanters bearing hairless ventral projections; female with apical plate of hind femur only about half covered with buff-golden setae and lateral portions of terga 3 and 4 convex, translucent and hollow beneath (forming acarinaria and often containing mites) 7

Male with fore and hind basitarsi straight and unmodified and fore trochanters lacking ventral projections; female with apical plate of hind femur almost wholly covered with dark brown hair and metasomal terga 3 and 4 lacking acarinaria ..... *C. rufescens*

7 Male with one hind tibial and no mid tibial spur and hind trochanter with a slender apical spine; female with mid ventral margin of clypeus evenly convex ..... *C. centralis*

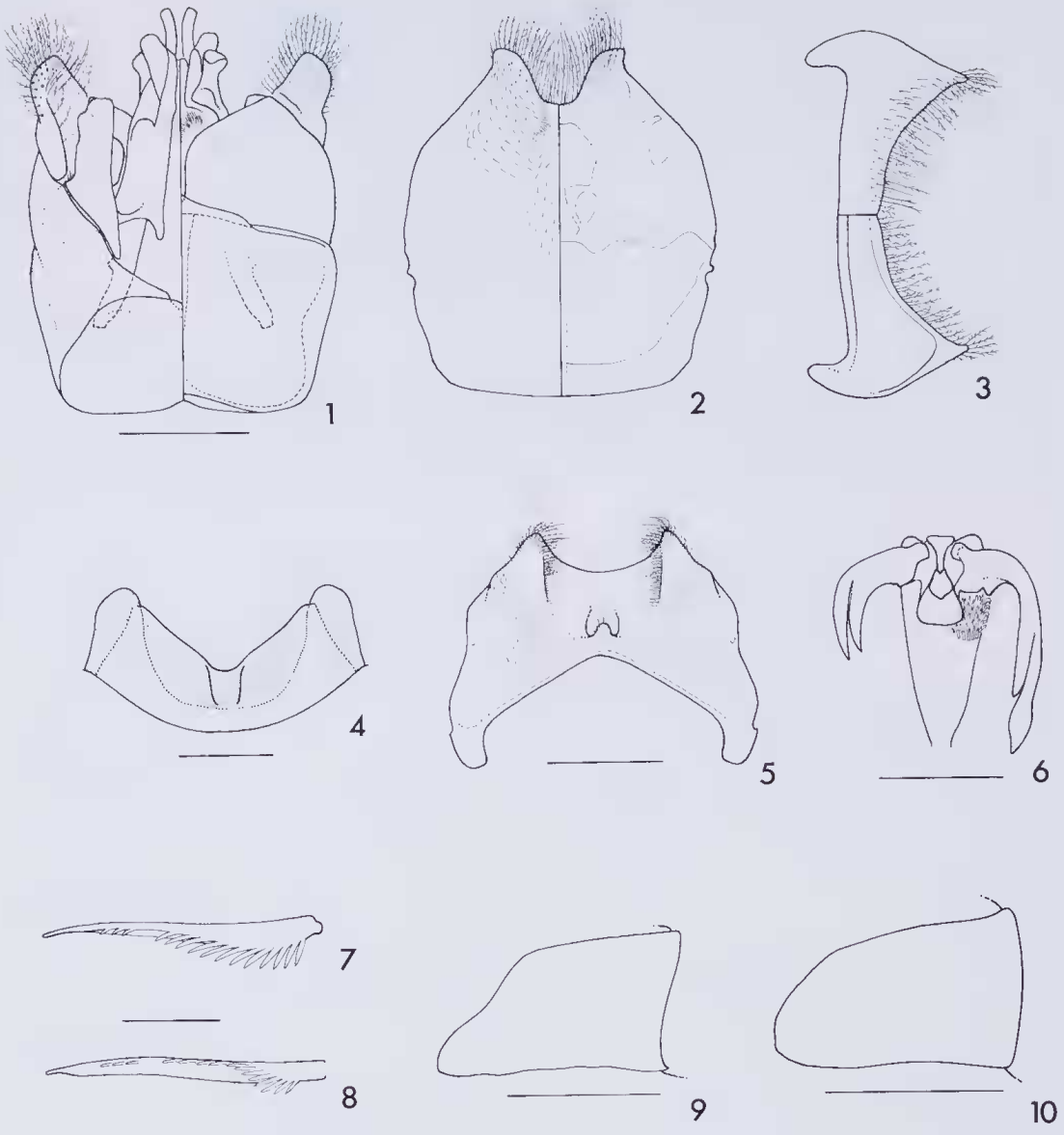
Male with two hind tibial and one mid tibial spurs and hind trochanter without a slender apical spine; female with mid ventral margin of clypeus with three prominences ..... *C. nicholsoni*

8 Integument of head and body predominantly bright metallic green ..... *C. smaragdinus*

Integument of head and body not at all metallic green 9

9 Metasomal terga each with broad, yellow, enamel-like, apical band ..... *C. tigris*

Metasomal terga wholly black ..... *C. ordensis*



Figures 1-10 *Ctenocolletes* spp. (1-4) *C. fulvescens* male: (1-3) genital capsule, 8th and 7th metasomal sterna (dorsal aspect shown on right, ventral on left; 7th sternum rotated 90° clockwise); (4) sketch of exposed portion of 6th metasomal sternum (ventral view; setae omitted; transparent membranous areas stippled). (5-9) *C. nigricans:* (5) 6th metasomal sternum of male (ventral view); (6) right fore distitarsus of male (ventral view); (7, 8) left mid tibial spur of female, anterior and ventral views; (9) right gonostylus of male (outer view). (10) Same of *C. albomarginatus.* Scale lines for 1-5 represent 1 mm, remainder represent 0.5 mm.

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Ctenocolletes albomarginatus Michener, 1965

Figures 10, 11

New Material Examined
Western Australia

East Yuna Nature Reserve, 34 km WNW of Mullewa (23-24 Sept. 1983, C.A. and T.F. Houston, on flowers of *Melaleuca nematophylla*, 9♀; 28-29 Aug. 1984, TFH and BPH, 1♂ on flowers of *Thryptomene strongylophylla*, 1♀ on flowers of *Melaleuca nematophylla;* 13-16 Sept. 1984, TFH, 3♀ ex nest burrows, 6♂ flying over bare sandy ground, 1♂ attracted to netted ♀, and 1♂ on flowers of *Baeckea* sp.).

The sexes were reliably associated after being collected together at a nesting site at East Yuna Nature Reserve. Males of this species and the new species *C. nigricans* are morphologically very similar.

Two errors occur in my description of the male (Houston 1983a, p. 276): the smallest recorded head width should be 4.45 mm and the largest upper interocular distance should be 45% of head width.

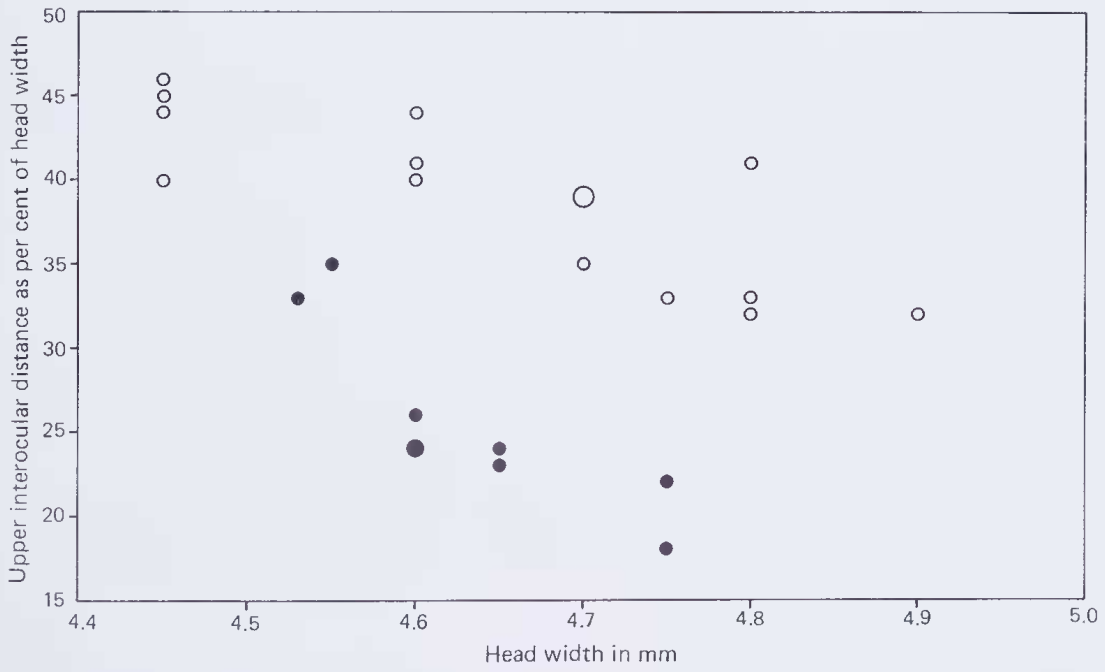

Figure 11 Scatter diagram showing relationship between male size (judged by head width) and degree of convergence of compound eyes on vertex (greater convergence is reflected by relatively smaller upper interocular distance). Open symbols represent *Ctenocolletes albomarginatus*, solid symbols represent *C. nigricans*. Small symbols represent one, medium two and large three males.

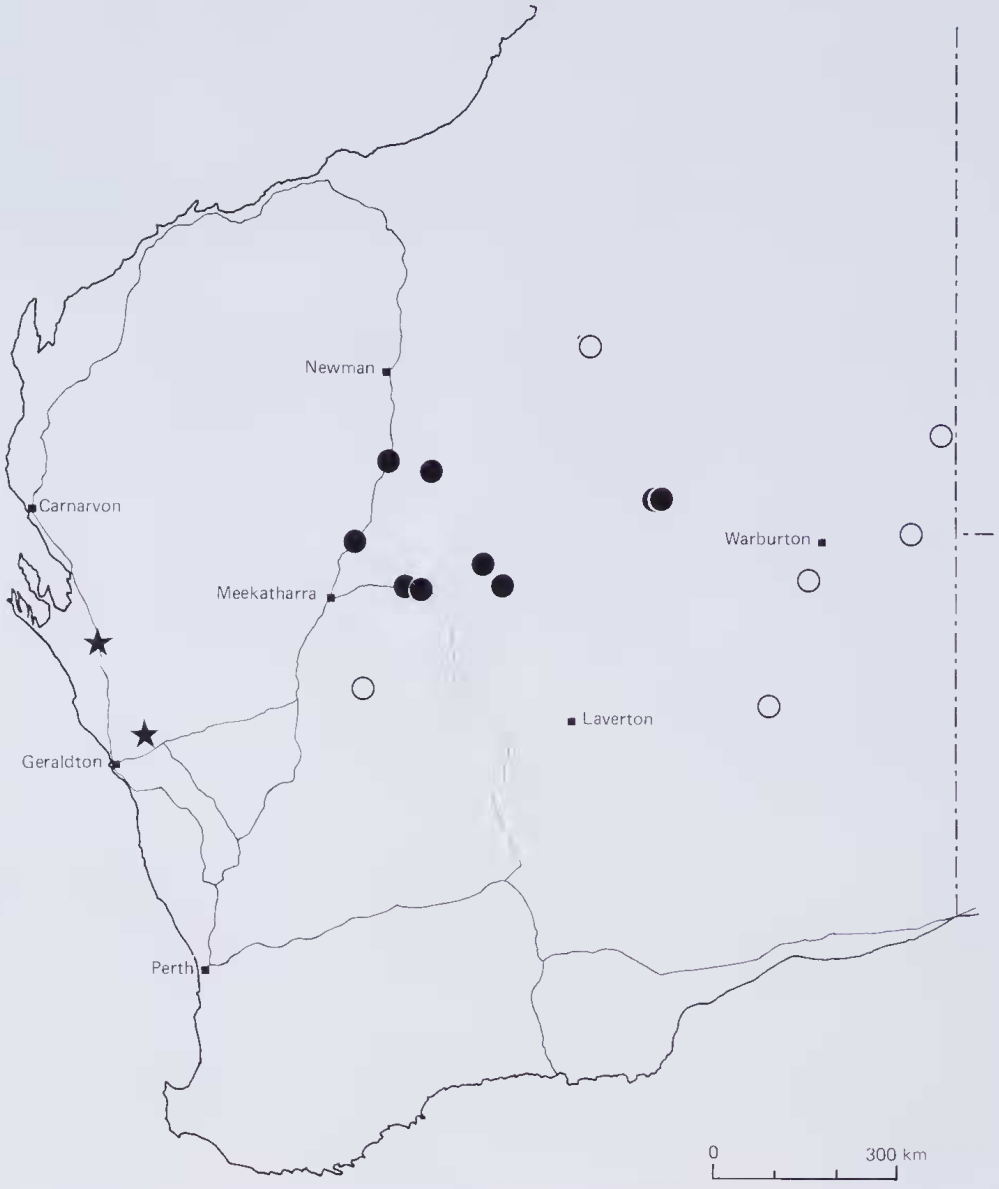

Figure 12 Map showing collection localities of *Ctenocolletes centralis* (circles) and *C. nigricans* (stars) in Western Australia. Open symbols represent previously published records and solid symbols new records. Fine lines represent major roads.

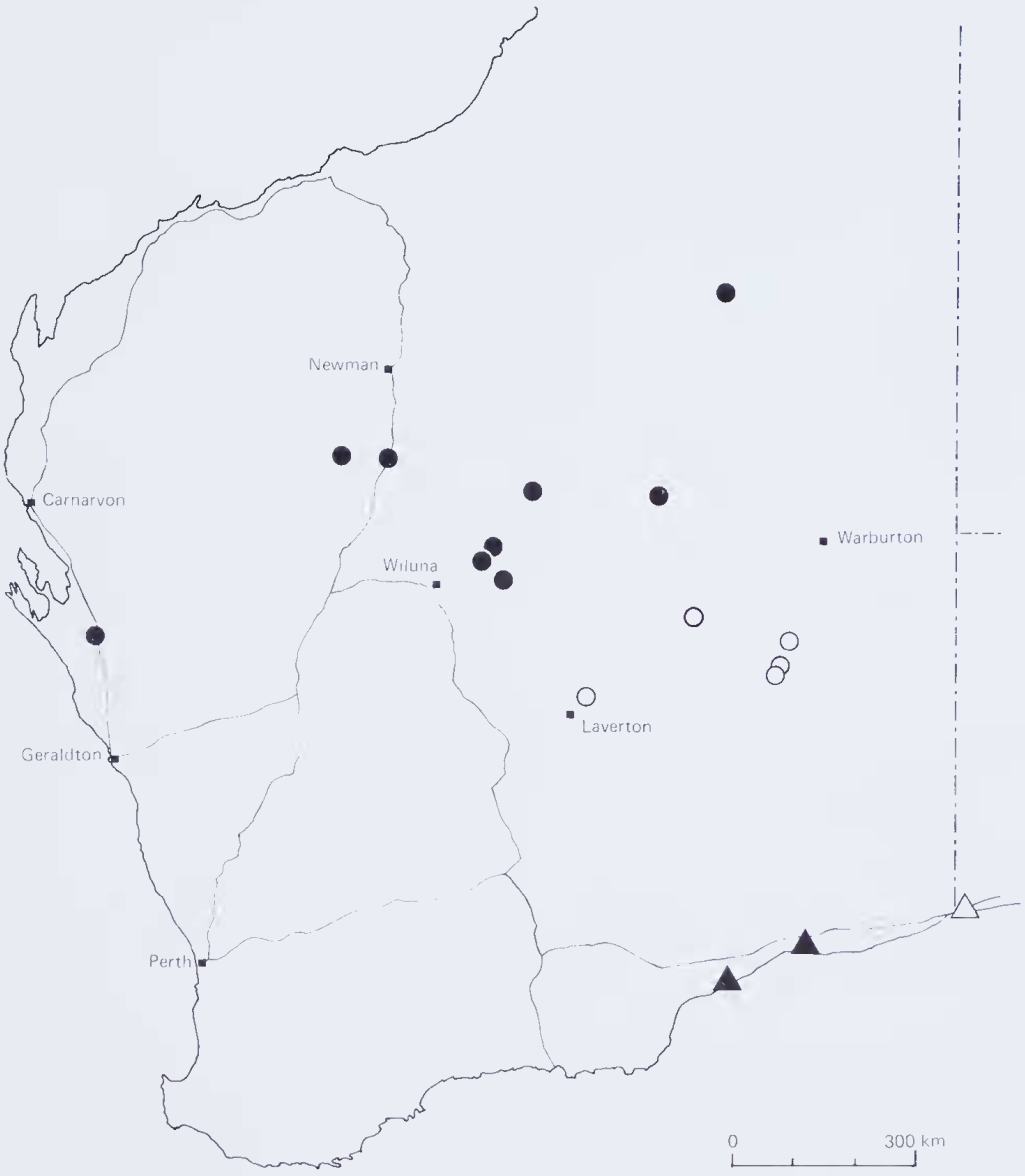

Figure 13 Map showing collection localities of *Ctenocolletes tigris* (circles) and *C. fulvescens* (triangles) in Western Australia. Open symbols represent previously published records and solid symbols new records. Fine lines represent major roads.

Ctenocolletes centralis Houston, 1983

Figure 12

New Material Examined

Western Australia

24-25 km ENE of Beyondie HS (24°47′S, 120°02′E), 17-20 Aug. 1984, TFH and BPH, on flowers of *Thryptomene maisonneuvii*, 1♂; 15 km N of Kumarina Hotel (24°42′S, 119°36′E), 21 Aug. 1984, TFH and BPH, on flowers of *Thryptomene maisonneuvii*, 2♂, 14♀; 48 km W of Lorna Glen HS (26°13′S, 121°33′E), 10 Aug. 1983, TFH and RPM, on flowers of *Acacia*, 1♀; 11 km SW of Mt Leake (25°47′S, 119°10′E), 16 Aug. 1984, TFH and BPH, on flowers of *Acacia pyrifolia*, 2♀; 8 km E of Mt Nossiter (25°25′S, 123°47′E), 7 Aug. 1983, TFH and RPM, on flowers of *Thryptomene maisonneuvii*, 2♂, 14♀; same data but 17 km E, on flowers of *Dicrastylis exsuccosa*, 3♀; 45 km WNW of Wiluna, 27-28 July 1983, TFH and RPM, on flowers of *Acacia tetragonophylla*, 2♀; same data but 17 km W, 28 July, hovering amongst *Triodia* hummocks, 4♂; same data but 115 km E, 29 July, on flowers of *Thryptomene maisonneuvii*, 6♂, *Acacia* sp. and *A. ligulata*, 3♀.

Recent collecting has consolidated the distributional picture (Figure 12) as essentially central Western Australian. This species and its closest relative *C. nicholsoni* appear more certainly to be parapatric.

Ctenocolletes fulvescens Houston, 1983

Figures 1-4, 13

New Material Examined

Western Australia

14 and 15 km N of Eyre HS (32°15′S, 126°18′E), 28 Feb.-4 Mar. 1984, TFH, on flowers of *Eucalyptus oleosa*, 9♂, 3♀, ANIC and WAM; 1.7-2.7 km NW of Toolinna Rockhole (32°45′S, 124°59′E), 24-28 Feb. 1984, TFH, on flowers of *Eucalyptus gracilis*, 12♂, 1♀, ANIC and WAM.

This species was previously known only from the unique holotype female from the extreme west of South Australia. It is now known to span a distance of about 400 km along the fringe of the Great Australian Bight in Western Australia (Figure 13).

The new material makes possible description of the male for the first time and amplification of the female description.

Male

Diagnosis

Easily distinguished from all other *Ctenocolletes* by absence of pygidial plate, orange-brown metasomal terga, light orange-brown pubescence of face and dorsal areas of mesosoma, and unique form of terminalia.

Description

Body length 14-17.5 mm; head width 4.6-5.3 mm (n 21).

Relative dimensions: HW 100; HL 84-90; UID 25-40; LID 63-66; MOD 8-9; OOD 6-10; SL 12-14; F1L 23-26; FRL 88-90; ML 42-44; MBW 15-16.

Head fairly rounded in anterior view; inner margins of eyes converging slightly to strongly above and vertex correspondingly convex or level; labrum very short as in female; mandible with prominent rounded anterior tooth; attenuated first segment of flagellum as long as next three segments together; first recurrent vein distal to first intercubitus by 25-40% of posterior length of second cubital cell; propodeal enclosure large enough to accommodate at least three ocelli; legs unmodified, all basitarsi fairly straight and uniformly thick; fore tarsal claws slightly asymmetrical, the inner claw not as strongly curved as the outer and thus appearing slightly longer; hind distitarsus (excluding claws) about 80-90% as long as distance from its insertion to base of second segment; metasoma highest and broadest basally, tapering apically and concave ventroapically; seventh tergum bare medially but without a pygidial plate; sixth sternum modified apically (Figure 4).

Integument black except as follows. Clypeus (except lateral and ventral margins) translucent yellow-brown. The following are orange-brown: labrum, scapes, flagella ventrally (sometimes also whole of attenuated basal segments), tegulae, bases of wing veins, legs distal to apices of femora, all metasomal terga (except basally) and margins of sterna. Hind margins of metasomal terga 2-6 broadly transparent.

Head capsule (except eyes and appendages), mesosoma and legs proximally with long, dense, plumose pubescence almost obscuring underlying integument; hair of face golden-buff; setae on vertex pale basally, dark brown more apically; hair of mesosoma very dense, erect, uniformly ginger on dorsal and lateral areas, very long on sides of propodeum; hair of genae, ventral areas of mesosoma, legs proximally and anterior sterna white; metasomal terga with much sparser ginger pubescence, especially 3-6 which have mostly simple setae.

Terminalia: see Figures 1-3.

Female

The original description (based on the unique holotype) is augmented by data from four further specimens.

Body length 17-20 mm; head width 5.5-6.2 mm.

Relative dimensions: HW 100; HL 81-84; UID 46-50; LID 70-71; MOD 7.5; OOD 14-15; SL 13-14; F1L 22; FRL 55-60; ML 43-45; MBW 16-17; C2L 30-35.

Propodeal enclosure varying from just too small to a little more than large enough to accommodate two median ocelli side by side; mid tibial spurs with 17-23 teeth; inner hind tibial spurs with 6-10 strong teeth (and sometimes 2 or 3 weak ones in addition); arolia present; attenuated first segment of flagellum as

long as next 3.5-4.0 segments; flange-like latero-apical margins of pygidial plate worn on older specimens leaving a pair of prominences more basally.

Ctenocolletes nigricans sp. nov.

Figures 5-9, 11, 12

Holotype

In WAM (84/1062), ♂, 13 km S of Wannoo (26°49′S, 114°37′E), Western Australia, 24-28 Aug. 1984, TFH and BPH, flying.

Paratypes

Western Australia

Same data as for holotype but *in copula*, 1♂, 1♀; East Yuna Nature Reserve, 34 km WNW of Mullewa (23-24 Sept. 1983, C. and T. Houston, on flowers of *Melaleuca nematophylla*, 4♀, ANIC and WAM; 28-29 Aug. 1984, TFH and BPH, on flowers of *Thryptomene strongylophylla*, 2♂).

Diagnosis

Most like *C. albomarginatus* and unlike other species in combining the following features: body black; pubescence chiefly white with some areas of black or blackish setae; all but apical and subapical metasomal terga with narrow apical bands of white tomentum (interrupted medially in male); inner fore tarsal claws of male conspicuously modified and much longer than outer claws; third and fourth metasomal terga of female convex laterally, concealing cavities (acarinaria) beneath.

Distinguishable from *albomarginatus* by the following features: inner fore tarsal claws of male relatively longer, 1.5-1.7X as long as outer claws and with tips of prongs separated by at least twice maximum width of longer outer prong (Figure 6); female with black (not orange) pubescence on fifth and sixth metasomal segments; further distinguishable in male by generally greater convergence of compound eyes on the vertex (Figure 11) and relatively shorter flagellum, and in female by relatively narrower head.

Description

Male (based on holotype; variation in paratypes given in parentheses).

Body length 15 (14-16) mm; head width 4.65 (4.53-4.75) mm.

Relative dimensions: HW 100; HL 82 (80-85); UID 24 (18-35); LID 58 (55-59); MOD 8; OOD 5 (5-8); SL 13; F1L 24 (23-25); FRL 72 (71-75); ML 42; MBW 13.

Form, coloration and pubescence as described for *albomarginatus* male (Houston 1983a, 276-277) except as already noted in diagnosis above and with the following additional differences. Inner orbits varying from slightly converging above in

smallest males to strongly converging in largest, vertex varying correspondingly from fairly level with tops of eyes to distinctly depressed below them; attenuated first segment of flagellum about as long as next four segments together; propodeal enclosure large enough to accommodate only one ocellus or, sometimes, two side by side; gonostyli with apices acute rather than rounded obtuse (cf. Figures 9 and 10); sixth sternum with tubercle at base of U-shaped membranous emargination (present also in *albomarginatus*) more prominent and set in a distinct pit (Figure 5).

Female

Body length 16-18 mm; head width 4.9-5.3 mm (n 5).

Relative dimensions: HW 100; HL 78-81; UID 50-53; LID 67-68; MOD 7.5-8.0; OOD 15-16; SL 13-14; F1L 22-23; FRL 53-56; ML 45 (worn) – 53; MBW 15; C2L 25-27.

Head moderately broad with face between eyes slightly longer than wide at top; vertex slightly raised above summits of eyes; mid ventral margin of clypeus gently concave; mandibles very slender with long posterior tooth; labrum more or less semicircular with triangular basal elevation occupying more than half its length and fringed beneath with plumose setae; attenuated first segment of flagellum as long as next 4.2-4.5 segments together; propodeal enclosure too small to accommodate a median ocellus; first recurrent vein of fore wing distal to first intercubitus by about one-third posterior length of second cubital cell; mid tibial spurs long and slender with 16-20 teeth, none of which is longer than shaft is thick, shafts flattened distally and not tapering uniformly viewed dorsally (Figures 7, 8), inner hind tibial spurs short and broad with 7-9 teeth, at least four robust; hind distitarsus about two-thirds as long as distance from insertion to base of segment 2; arolia present; lateral portions of metasomal terga 3 and 4 convex and hollow beneath forming acarinaria (cf. Houston 1984, 169); pygidial plate fairly flat with even margin, finely pitted.

Integument almost entirely black but tibial spurs brown and mandibles apically and fore tibiae medially suffused with brown; wings distally smoky brown.

Pubescence predominantly white; scutum, scutellum and axillae almost wholly covered with short, erect, black pubescence but narrowly margined with white; blackish pubescence also on vertex and occiput, small patches posterior to pronotal lobes, dorsally on hind tibiae and all tarsi (except white outer basal patches on hind basitarsi), propodeum with abundant long white pubescence; metasomal terga 1-4 with narrow apical fringes of white tomentum, otherwise with sparse covering of short simple black setae; metasomal segments 5 and 6 with long black pubescence dorsally and ventrally; sterna 2-4 with apical fringes of long white highly plumose setae.

Distribution

Geraldton region, Western Australia (Figure 12).

Remarks

The sexes were positively associated by capture of a mating pair.

This species is much closer phylogenetically to *albomarginatus* than is *tricolor* Houston and is sympatric with it. The possibility that it may be only a variety of that species seems unlikely in view of its several consistent morphological differences. Some behavioural differences were also noted but will be described elsewhere.

The specific epithet is Latin for 'becoming black' and alludes to the dominance of black in the colour pattern.

Ctenocolletes ordensis Michener, 1965

New Material Examined

Western Australia

8 km E of Greenhead (30°04′S, 114°58′E), 31 Aug. 1982, RPM, in *Acacia* blossom, 1♀.

This record is the most westerly to date.

Ctenocolletes tigris Houston, 1983

Figure 13

New Material Examined

Western Australia

10 km SW of Glenayle HS (25°16′S, 122°02′E), 8 Aug. 1983, TFH and RPM, on flowers of *Dicrastylis exsuccosa*, 1♀; *c.* 26 km SE of Kidson Bluff (22°16′S, 125°04′E), 3-4 Aug. 1983, TFH and RPM, on flowers of *Dicrastylis exsuccosa*, 2♂; 15 km N of Kumarina Hotel (24°42′S, 119°36′E), 21 Aug. 1984, TFH and BPH, on flowers of *Thryptomene maisonneuvii*, 1♀; 30 km NW of Lorna Glen HS (26°13′S, 121°33′E), 10 Aug. 1983, TFH and RPM, on flowers of *Solanum lasiophyllum*, *in copula*, 2♂, 2♀; same data but 48 km W, patrolling white flowers of *Grevillea* at high speed, 1♂; 17 km E of Mt Nossiter (25°25′S, 123°47′E), 7 Aug. 1983, TFH and RPM, on flowers of *Dicrastylis exsuccosa*, 2♂; 16 km SW of Tangadee HS (24°25′S, 118°56′E), 22 Aug. 1984, TFH and BPH, on flowers of *Newcastelia bracteosa* (1♂) and *Ptilotus* sp. (1♂); 13 km S of Wannoo (26°49′S, 114°37′E), 24-28 Aug. 1984, TFH and BPH, burrowing in level sand (1♀) and on flowers of *Teucrium* sp. (7♂); 115 km E of Wiluna, 29 July 1983, TFH and RPM, on flowers of *Thryptomene maisonneuvii*, 1♂.

Originally described from the Laverton-Warburton region of Western Australia, this species is now shown to be very widely distributed through the Eastern Division of that State and extends through the North-West Division to near the coast between Shark Bay and Kalbarri (Figure 13). It seems likely that the range may also extend into western parts of South Australia and the Northern Territory. Almost all collection localities are sand plain or sand ridge habitats.

Discussion

When I devised a cladogram of eight species of *Ctenocolletes* then known (Houston 1983a, Figure 58) I was hampered by not knowing the character states for the male of *C. fulvescens*. Now that they are known it is still not possible to clearly ally the species with another or a group of species in the genus. However, this species may be confidently excluded from my clade E containing *C. ordensis* and *C. smaragdinus* (Smith) and to which *C. tigris* was subsequently added (Houston 1983b). While it shares more character states with members of my clade D (containing all other species), most of these states are presumed to be ancestral and none is unquestionably derived. Thus I remain uncertain whether *C. fulvescens* is to be regarded as a sister species to all other *Ctenocolletes* or just to clade D species.

Prior to discovery of the male of *C. fulvescens*, the presence of a pygidial plate was one of the chief diagnostic features used to distinguish males of *Ctenocolletes* from those of *Stenotritus* (Michener 1965, Houston 1983a). However, as noted in the descriptive text, the male of *C. fulvescens* lacks a pygidial plate and the question arises as to whether the species has lost the plate independently or retained a condition which is ancestral for Stenotritidae as a whole. This is a problem which may not be resolvable with certainty. Michener (1981: 11) considered absence of the plate in males of certain Melittidae to be derived because the plate is widespread and doubtless plesiomorphic in bees. He noted, however, that 'reversal is possible, probably because genes specifying the plate are retained in females and have only to be activated in males'.

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